3.1.1 Filtering Feasibility Criteria

All utilities shall have a minimum 5' horizontal clearance from the facility.

The maximum contributing area to an individual storm water filtering system is usually less than 10 acres.

Filtering systems are typically not to be designed to provide storm water detention (Qp_2, Qp_{15}, and / or Q_f), but they may be in some circumstances. Filtering practices shall generally be combined with a separate facility to provide those controls. However, in combined sewer areas, the three-chamber underground sand filter can be modified by expanding the first or settling chamber, or adding an extra chamber between the filter chamber and the clear well chamber to handle the detention volume, which is subsequently discharged at a pre-determined rate through an orifice and weir combination.

All filtering systems shall be located in areas where they are accessible for inspection and for maintenance (by vacuum trucks).

The seasonally high groundwater table and bedrock shall be located at least 4 feet below the footing of the structure.

A geotechnical report is required for all underground BMPs, including filtering systems. Geotechnical testing requirements are outlined in Appendix E.

Since sand filters are gravity flow systems that normally require 2 to 6 feet of head, sufficient vertical clearance between the inverts of the inflow and outflow pipes shall be provided. Whenever there is insufficient hydraulic head for a three-chamber underground sand filter, a well pump may be used to discharge the effluent from the third chamber into the receiving storm or combined sewer.

For three-chamber sand filters in combined-sewer areas, a water trap shall be provided in the third chamber to prevent the back flow of odorous gas.

The one-chamber sand filter is only applicable for impervious area less than 10,000 ft^2 (1/4 acre).

3.1.2 Filtering Conveyance Criteria

If runoff is delivered by a storm drain pipe or is along the main conveyance system, the filtering practice shall be designed off-line.

An overflow shall be provided within the practice to pass storms greater than the V_w storage to a stabilized water course.

3.1.3 Filtering Pretreatment Criteria

Dry or wet pretreatment shall be provided prior to filter media.

Adequate pretreatment for bioretention systems (F-7) is provided when all of the following are provided: (a) grass filter strip below a level spreader, (b) gravel diaphragm and (c) a mulch layer.

3.1.4 Filtering Treatment Criteria

The entire treatment system (including pretreatment) shall temporarily hold at least 75% of the V_w prior to filtration.

The filter bed typically has a minimum depth of 18". The perimeter filter may have a minimum filter bed depth of 12".

The filter media shall consist of a medium sand (meeting ASTM C-33 concrete sand). Media used for organic filters (F-6) may consist of peat/sand mix or leaf compost. Peat should be a reed-sedge hemic peat.

Bioretention systems (F-7) shall consist of the following treatment components: A four foot deep planting soil bed, a surface mulch layer, and a 6" deep surface ponding area.

Design Procedure for Storm Water Filtering Systems

Recommended steps to be considered when designing a storm water filtering system are as follows:

1. Examine the topographical conditions of the site and select possible outfalls from the existing drainage or sewer map.

2. Review the final grading plans and determine the maximum head available between the proposed inflow and outflow pipes.

3. Determine the total connected impervious area.

4. Select the runoff depth to be treated based on land use characteristics (Table 2.2). Calculate the water quality volume (V_w) to be treated.

5. Estimate the storage volume and the release rate.

6. Select design storm(s): This should be based on the storm frequencies selected by the Department.

7. Determine the size of the inflow, outflow and emergency release pipes: These should be sized to pass the highest selected storm frequency permitted by the Department. The District of Columbia uses the 15-year storm (with t_c = 5 min) for post-development runoff.

8. Determine detention time: All filter systems should be designed to drain the first-flush runoff from the filter chamber within 5 to 24 hours after each rainfall event.

9. Determine structural requirements: A licensed structural engineer should certify the structural integrity of the design in accordance with local building codes.

10. For underground structures, provide sufficient headroom for maintenance: A minimum head space of 5 feet above the filter is recommended for maintenance of the structure. However, if 5 feet headroom is not available, a removable top should be installed.

Specific Design Methodology: Three-Chamber Underground Sand Filter

The three-chamber underground sand filter is a gravity flow system. The facility may be precast or cast-in-place. The first chamber acts as a pretreatment facility removing any floating organic material such as oil, grease, and tree leaves. It should have a submerged orifice leading to a second chamber and it should be designed to minimize the energy of incoming storm water before the flow enters the second chamber (filtering or processing chamber).

The second chamber is the filter chamber. It should contain three feet of filter material consisting of gravel, geotextile fabric, and sand, and should be situated behind a three foot weir. Along the bottom of the structure should be a subsurface drainage system consisting of a parallel PVC pipe system in a gravel bed. A dewatering valve should be installed at the top of the filter layer for safety release in cases of emergency. A by-pass pipe crossing the second chamber to carry overflow from the first chamber to the third chamber is required.

The third chamber is the discharge chamber. It should also receive the overflow from the first chamber through the bypass pipe when the storage volume is exceeded.

Water enters the first chamber of the system by gravity or by pumping. This chamber removes most of the heavy solid particles, floatable trash, leaves, and hydrocarbons. Then the water flows to the second chamber and enters the filter layer by overtopping a weir (3 feet above the bottom of the structure). The filtered storm water is then picked up by the subsurface drainage system that empties it into the third chamber.

1. Determine Design Invert Elevations

Determine the final surface elevation, invert in, invert out and bottom invert elevation of the structure, see Figure 3.10.

$$D_t = \left(Inv_{in} - Inv_{out}\right) + D_b + 1 \tag{3.1}$$

Where:
- D_t = total depth of structure (ft)
- Inv_{in} = final invert elevation of inflow pipe (ft)
- Inv_{out} = final invert elevation of outflow pipe (ft)
- D_b = diameter of bypass pipe (ft)
- 1 = freeboard constant (ft)

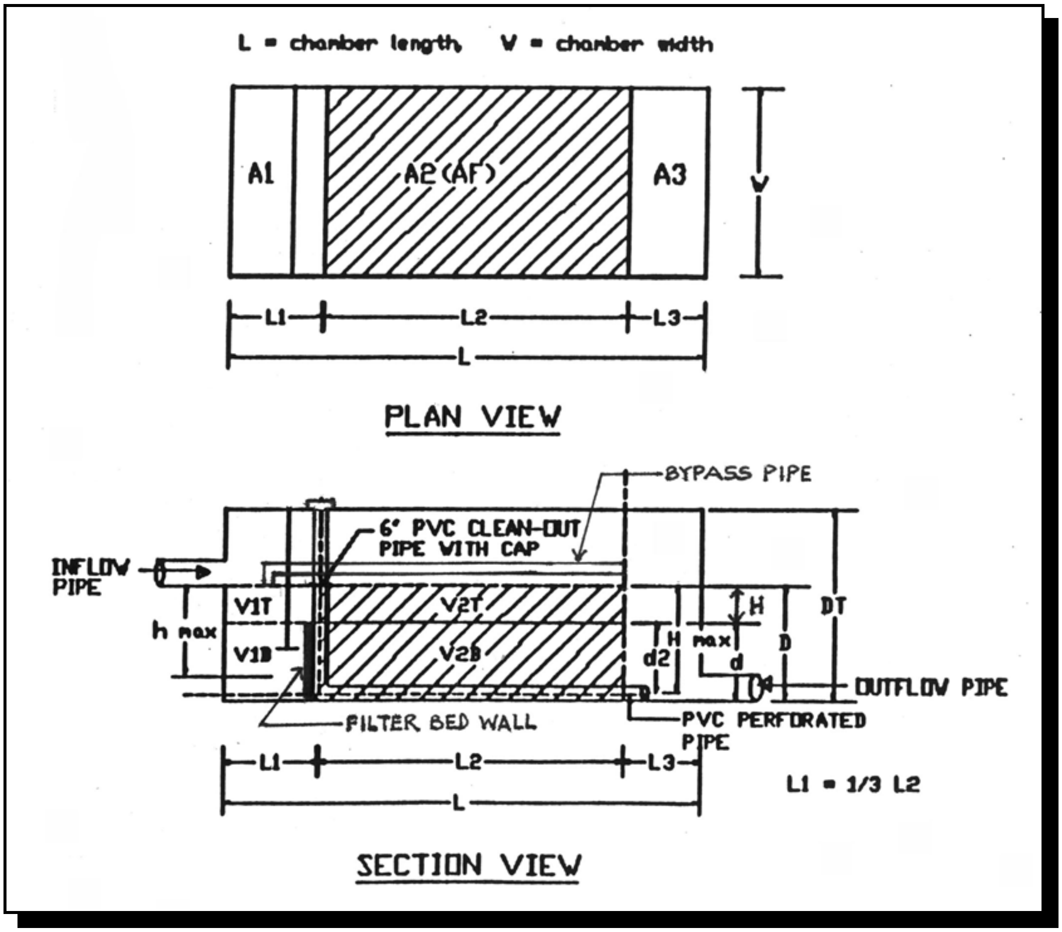

Figure 3.10 Design Guide for the Standard Sand Filter

2. Peak Discharge Calculation for Bypass Flow

The bypass pipe is sized to pass the 15-year event. Using the Rational Method:

$$Q_p = C * I * A \tag{3.2}$$

Where: Q_p = bypass peak flow (cfs)
C = runoff coefficient (dimensionless)
I = rainfall intensity (in/hr)
A = drainage area (ac)
t_c = time of concentration (minute or hr)
= t_d, storm duration, use in selecting rainfall intensity (minute or hr)

Note: The District of Columbia uses the 15-year storm (with t_c = 5 minutes) for post-development runoff. The District of Columbia Rainfall Intensity - Duration - Frequency curve is provided in Appendix A.

3. Determine Sand Filter Area A_f

Use Figure 3.11 or the following equation:

$$A_f = 50 + \left(I_a - 0.1\,\text{ac}\right) * \left(167\ \text{ft}^2 / \text{ac}\right) \tag{3.3}$$

Where: A_f = surface area of filter layer (second chamber) (ft^2)
I_a = impervious area (ac)

4. Determine Storage Volume Needed

$$V_s = V_w - \left(F * T * A_f\right) \tag{3.4}$$

Where: V_s = storage volume needed to hold the first flush runoff (ft^3)
V_w = water quality volume (ft^3)
F = infiltration rate for sand (ft/hr) $\approx$1.18 ft/hr
T = filtering time (1 hour based on NRCS practice)
A_f = sand filter area (ft^2)

5. Calculate Submerged Storage Volume in Second Chamber

$$V_{2b} = A_f * d_f * n \tag{3.5}$$

Where:
V_{2b} = submerged volume of filter chamber (ft^3)
A_f = surface area of filter layer (second chamber) (ft^2)
d_f = depth of filter layer (ft)
n = composite of porosity for filter media

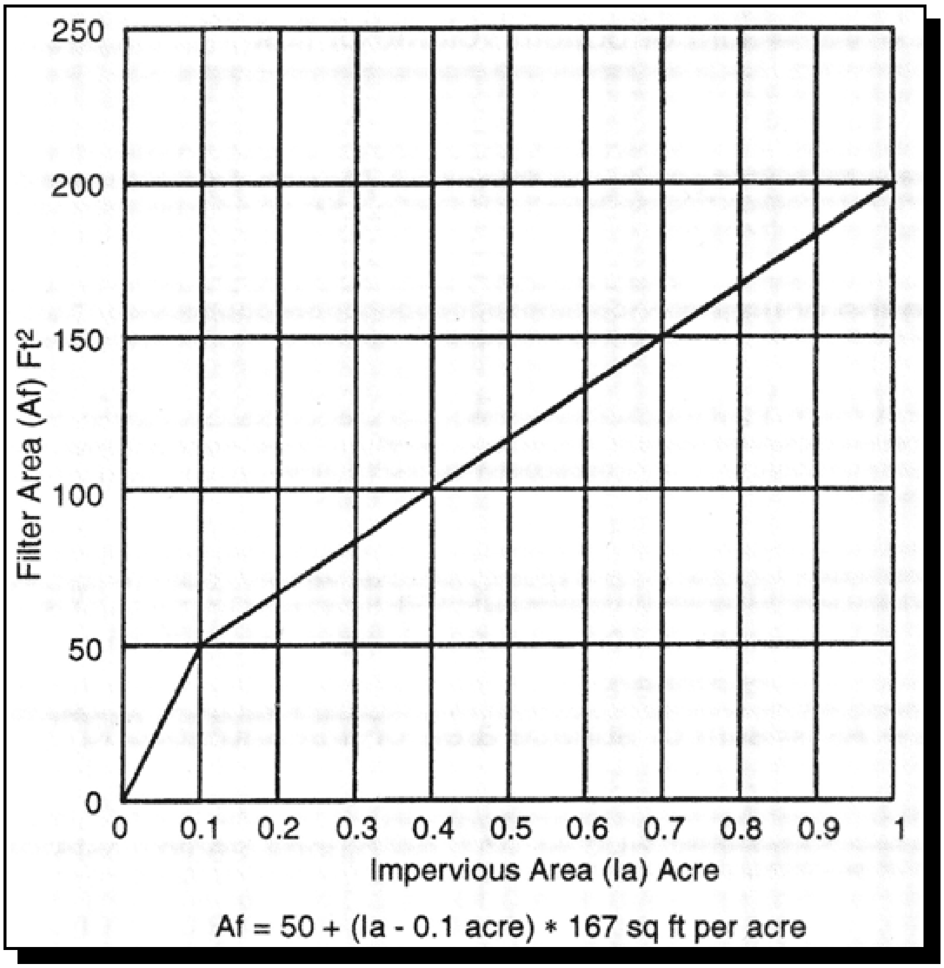

Figure 3.11 Determination of Filter Area

6. Calculate Submerged Storage Volume in First Chamber

$$V_{1b} = A_1 * d_f \qquad (3.6)$$

Where: V_{1b} = submerged volume of first chamber (ft^3)
A_1 = surface area of first chamber (ft^2)
d_f = depth of filter layer (ft)

Note: $A_f/3 < A_1 < A_f/2$, for optimum design condition

7. Calculate Surface Storage Volume in First & Second Chambers

$$\left(V_{1t} + V_{2t}\right) = V_s - \left(V_{2b} + V_{1b}\right) \qquad (3.7)$$

Where: $V_{1t} + V_{2t}$ = sum of surface volume of first & second chambers (ft^3)
V_s = storage volume needed to hold the first flush runoff (ft^3) (from eq. 3.4)
$V_{2b} + V_{1b}$ = sum of submerged volume of first & second chambers (ft^3)

8. Determine Maximum Storage Depth

$$D = H + d_f \qquad (3.8)$$

Where: D = maximum storage depth (ft)
H = vertical distance between top of filter layer and bottom of bypass pipe outlet

$$= \frac{\left(V_{1t} + V_{2t}\right)}{\left(A_1 + A_f\right)}$$

$V_{1t} + V_{2t}$ = sum of surface volume of first & second chambers (ft^3)
$A_1 + A_f$ = sum of surface area of first chamber & filter layer (second chamber) (ft^2)
d_f = depth of filter layer (ft)

Note: D must be equal to or smaller than the difference between the invert in and invert out

9. Determine Size of Submerged Bypass Pipe

First, determine the submerged weir opening in first chamber, assuming orifice conditions:

$$Q_p = C * A_{w1} * \sqrt{2gh_{max}}$$

Therefore:

$$A_{w1} = \frac{Q_p}{C * (2gh_{max})^{0.5}} \tag{3.9}$$

Where:
- A_{w1} = area of weir opening in first chamber (ft^2) = $h_{w1} * l_{w1}$
- h_{w1} = weir height, minimum 1 ft
- l_{w1} = weir length (ft)
- Q_p = bypass peak flow (cfs) (from eq. 3.2)
- C = 0.6, orifice coefficient
- g = 32.2 ft/sec^2
- h_{max} = hydraulic head above the center line of weir (ft) from centroid of orifice?

Determine the capacity of the bypass pipe:

$$D_b = \left[\frac{2.16 * n * Q_p}{\sqrt{S}}\right]^{0.375} \tag{3.10}$$

Where:
- D_b = estimated bypass pipe diameter (ft)
- n = roughness coefficient (may vary from 0.011 to 0.021 depending on material)
- Q_p = bypass peak flow (cfs) (from eq. 3.2)
- S = pipe slope (use a slope value of 0.1% to 1%)

Note: PVC is normally preferred for the bypass pipe (n = 0.011)

In combined sewer areas, when the system is sized for both quantity and quality control, the following equation shall be used to size the quantity volume:

$$V_q = \left(Q_{p15} - Q_{p2}\right) * t_c * 1.25 \qquad (3.11)$$

Where:
V_q = quantity volume (ft^3)
Q_{p15} = 15-year peak flow (cfs)
Q_{p2} = 2-year peak flow (cfs)
t_c = time of concentration (minutes)

The water quality volume (V_w) shall be computed. Then the quantity control volume (V_q) shall also be computed using Equation 3.11.

The larger of the two volumes shall be used to size the sand filter structure. The last chamber should be divided into a third and fourth chamber. A rectangular weir and an orifice (at the bottom) shall be provided in the third chamber to control the excess volume from quantity control.

The overflow weir opening in the third chamber shall be designed to carry the 15-year design storm, while the orifice at the bottom shall be designed to handle the 2-year pre-development peak flow, using the submerged orifice formula (Equation 3.9).

10. Determine Flow Through Filter and Detention Time After Storage Volume Fills Up

Average flow through the filter:

$$q_f = k * A_f * i \qquad (3.12)$$

Where:
q_f = average flow through the filter (ft^3/hr)
k = sand permeability (ft/hr)
A_f = surface area of filter layer (ft^2)
i = hydraulic gradient (ft/ft) = h_{max} / (2 * d_f)

Estimate the detention time:

$$T_s = \frac{V_s}{q_f} \qquad (3.13)$$

Where:
T_s = average dewatering time for sand filter (hr)
V_s = storage volume needed (ft^3) (from eq. 3.4)
q_f = average flow through the filter (ft^3/hr) (from eq. 3.12)

11. Develop Inflow and Outflow Hydrographs

Figure 3.12 is a typical illustration of inflow/outflow hydrographs for a sand filter. For the inflow hydrograph, use the Modified Rational Method Hydrograph with:

$$t_p = t_c \quad \text{and}$$

$$t_R = 1.67\, t_c \tag{3.14}$$

Where: t_p = time to peak
t_c = time of concentration
t_R = recession period

For the outflow hydrograph use the following equations to determine when flow occurs.

When: $t_c * Q_p < 2V_s$ Then

$$t_p = 2t_c - \left(2t_c^2 - \frac{2V_s * t_c}{Q_p}\right)^{0.5} \tag{3.15}$$

When: $t_c * Q_p = 2V_s$ Then

$$t_p = 0.5t_c + \left(\frac{V_s}{Q_p}\right) \tag{3.16}$$

When: $t_c * Q_p > 2V_s$ Then

$$t_p = \left[\frac{2V_s * t_c}{Q_p}\right]^{0.5} \tag{3.17}$$

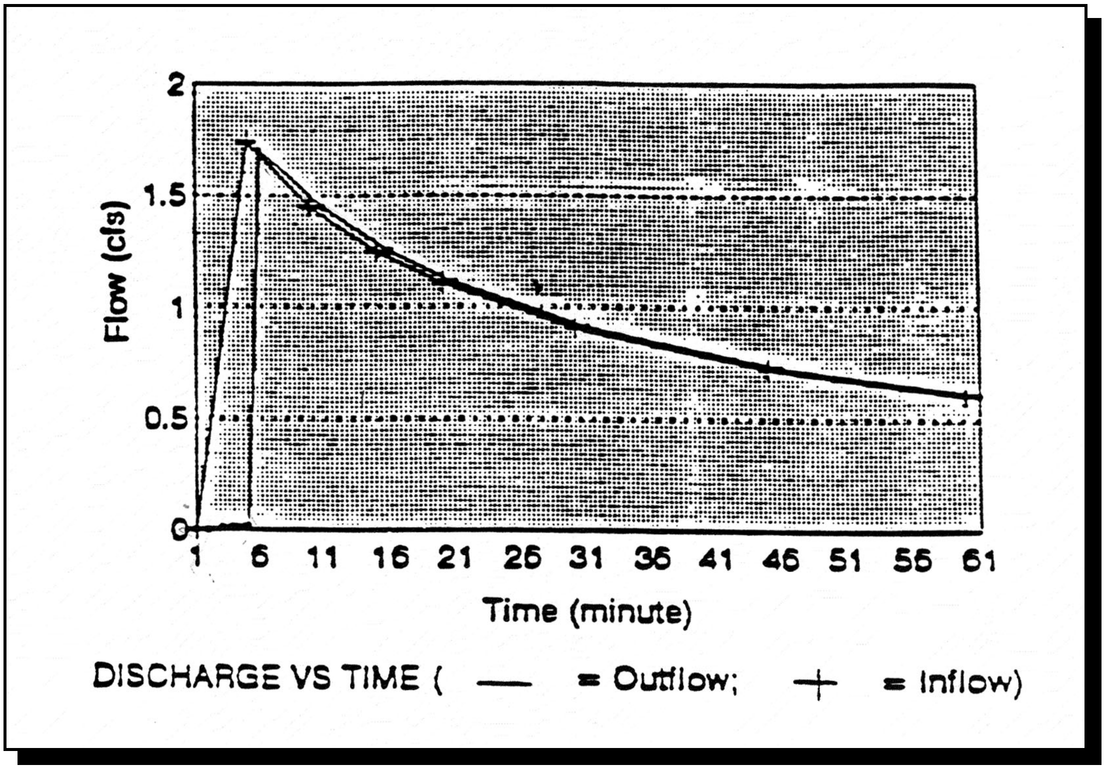

Figure 3.12 Typical Inflow and Outflow Hydrographs

Specific Design Methodology: One-Chamber Underground Sand Filter

The one-chamber underground sand filter is a gravity flow system. The water enters the system from a remote sump catch basin used as a primary settling device to remove trash, leaves, oil, grease and heavy sediment. It must be designed off-line with a flow splitter to maintain system efficiency.

1. Determine Design Invert Elevations
    (same as for three-chamber underground sand filter --- See Step 1)

2. Peak Discharge Calculation for Bypass Flow
    (same as for three-chamber underground sand filter --- See Step 2)

3. Determine Horizontal Cross Section Area (Filter Area)
    (same as for three-chamber underground sand filter --- See Step 3)

4. Determine Storage Volume Needed
    (same as for three-chamber underground sand filter --- See Step 4)

5. Determine Maximum Storage Depth
(same as for three-chamber underground sand filter --- See Step 8)

6. Determine Flow through Filter and Dewatering Time (T_d)
(same as for three-chamber underground sand filter --- See Step 10)

7. Develop Inflow and Outflow Hydrographs
(same as for three-chamber underground sand filter --- See Step 11)

Specific Design Methodology: Vertical Sand Filter

The vertical sand filter is a gravity-flow system consisting of three chambers. The first chamber is a pretreatment chamber that removes floatable organic material such as oil, grease, tree leaves and heavy sediment particles. It has a submerged orifice leading to a second chamber. The second chamber is the process chamber that has a 3 foot vertical filter with 4" diameter holes. The filter material is the same as the three-chamber sand filter. It has features that are similar to the three-chamber sand filter, such as a sub-surface drainage system, a bypass pipe, and a dewatering valve. The third chamber also receives the overflow from the second chamber or the first chamber depending on the initial design selection.

The design procedure is the same as the three-chamber underground sand filter except the following steps must be modified to meet the calculation requirements:

1. Determine Area of Sand Filter

$$A_f = 0.3\left[50 + \left(I_a - 0.1\,ac\right) * 167\ ft^2 / ac\right] \tag{3.18}$$

Where: A_f = $A_{fv} + A_{fh}$ total filter area (ft^2)
A_{fv} = vertical filter area -- wall area (ft^2)
A_{fh} = horizontal filter area -- area on top of filter layer (ft^2)
I_a = impervious area (ac)

2. Estimate the Detention Time

Draw down time from storage level 1 to storage level 2

$$q_{t1} = k * A_f * i$$

$$t_{d1} = \frac{V_w}{q_{t1}} \tag{3.19}$$

Draw down from storage level 2 to the bottom of structure

$$q_{t2} = k * A_{fv} * i$$

$$t_{d2} = \frac{V_w}{q_{t2}} \tag{3.20}$$

Total detention time:

$$T_d = t_{d1} + t_{d2} \tag{3.21}$$

Where:
k = sand permeability (ft/hr)
i = hydraulic gradient (ft/ft) = h_{max} / (2 * d_f)
q_{t1} = discharge from maximum storage level to level 2 (cfs)
q_{t2} = discharge from storage level 2 to bottom structure (cfs)
t_{d1} = draw down time of level 1 (sec)
t_{d2} = draw down time of level 2 (sec)
T_d = total dewatering time from the system (sec)

Specific Design Methodology: Perimeter Sand Filter

The perimeter sand filter consists of two parallel trenches connected by a series of overflow weir notches at the top of the partitioning wall, which allows water to enter the second trench as sheet flow.

The first trench is a pretreatment chamber removing heavy sediment particles and debris. The second trench consists of at least 12" of sand. A subsurface drainage pipe must be installed in the gravel bed at the bottom of the second chamber to facilitate the filtering process and convey filter water into a receiving system.

The following procedures should be used in designing the perimeter sand filter:

1. Calculate the Required Surface Area of the Filter Bed

Use Figure 3.11 or equation 3.3:

$$A_f = 50 + (I_a - 0.1\,ac) * 167\ ft^2 / ac$$

2. Calculate the Total Surface Area of the Perimeter Sand Filter

$$A_t = 2A_f \tag{3.22}$$

Where: A_t = total surface area of the perimeter sand filter (ft^2)
A_f = sand filter area (ft^2)

3. Calculate the Storage Depth of the Perimeter Sand Filter

$$D_t = \frac{V_w}{A_t} + d_f \tag{3.23}$$

Where: D_t = storage depth of the trench (ft)
V_w = water quality volume (ft^3)
A_t = total surface area of the perimeter sand filter (ft^2)
d_f = depth of filter layer (ft)

4. Calculate the Overflow Weir Height

$$h = D_t = \frac{V_w}{A_t} + d_f \tag{3.24}$$

Where: h = overflow weir height (ft)
D_t = storage depth of the trench (ft)
V_w = water quality volume (ft^3)
A_t = total surface area of the perimeter sand filter (ft^2)
d_f = depth of filter layer (ft)

5. Calculate the Size of Overflow Weir

$$Q_p = C * L_w * h^{1.5} \tag{3.25}$$

Where:
Q_p = bypass flow (cfs)
C = 3.33, weir coefficient
L_w = length of weir opening (ft)
h = overflow weir height (ft)

6. Determine the Final System Dimensions

$$L = \frac{A_t}{W} + 3 \tag{3.26}$$

Where:
L = total length of the perimeter sand filter(ft)
A_t = total surface area of the perimeter sand filter (ft^2)
W = total width of the perimeter sand filter, use 4 ft to begin the first trial (ft)

Specific Design Methodology: Surface Sand Filter

The surface sand filter consists of a sedimentation basin followed by a filtration basin. The most common filter media is sand; however, a peat/sand mixture may be used to increase the removal efficiency of the system. Two possible configurations of the filtration systems are described below:

1. Full Sedimentation: In this system, the sedimentation basin should be designed to hold the entire water quality volume (V_w) and to release it to the filtration basin over an extended period of dewatering time (Figure 3.13).
2. Partial Sedimentation: In this system, a sedimentation basin should not be designed to hold the entire water quality volume (V_w) and should not incorporate an extended drawdown period (Figure 3.14).

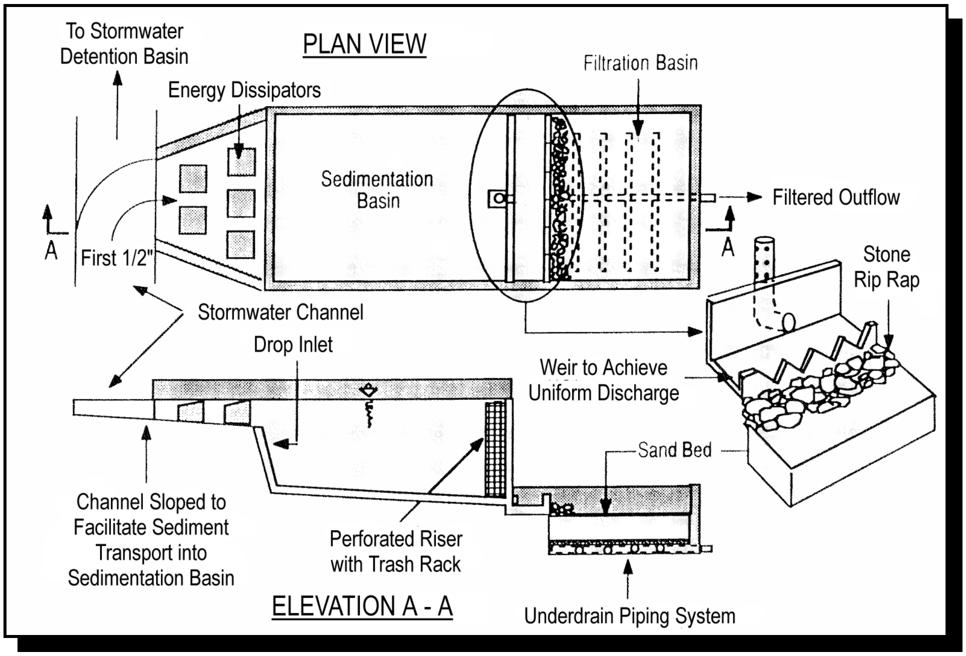

Figure 3.13 Conceptual Full Sedimentation Filtration System

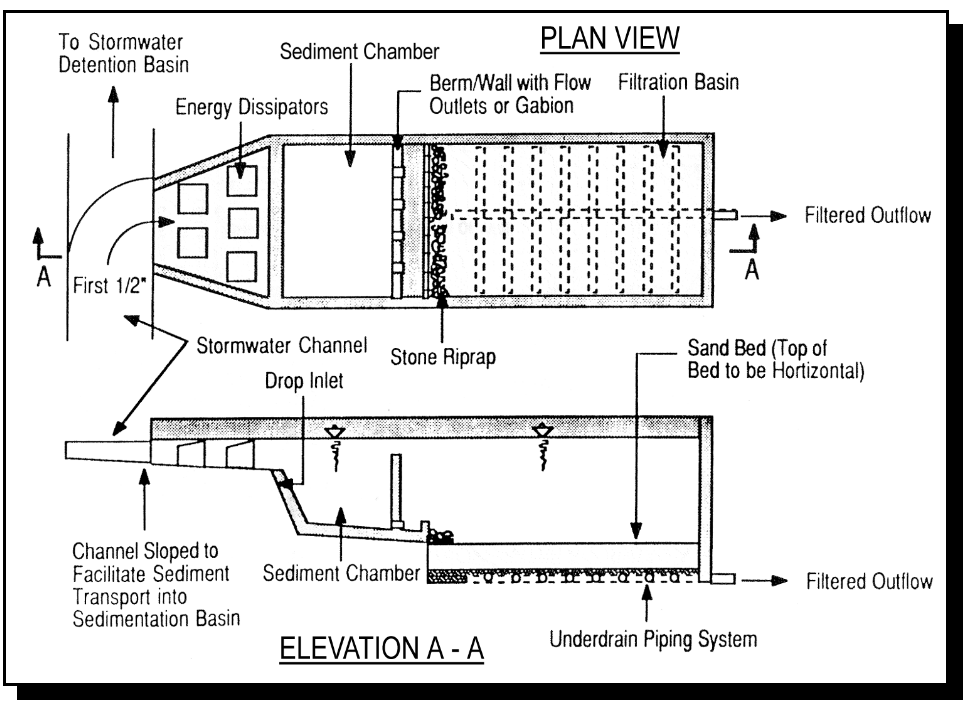

Figure 3.14 Conceptual Partial Sedimentation Filtration System

Design Methodology for Full Sedimentation with Filtration

1. Calculate the Basin Surface Areas

Filtration basin surface area:

$$A_f = \frac{V_w d_f}{k\left(h + d_f\right)t_f} \tag{3.27}$$

Where:
- A_f = surface area of filtration basin (ft^2)
- V_w = water quality volume to be treated (ft^3)
- d_f = sand bed depth (ft)
- k = coefficient of permeability for sand filter (ft/hr)
- h = average depth of water above surface of sand media (½ maximum depth) (ft)
- t_f = time required for runoff volume to pass through filter media (hr)

Sedimentation basin surface area:

$$A_s = \frac{I_a R}{10} \tag{3.28}$$

Where:
- A_s = surface area of sedimentation basin (ac)
- I_a = impervious drainage area (ac)
- R = runoff depth to be treated (Table 2.2) (ft)

2. Calculate the Basin Volumes

For the sedimentation basin, the storage volume (V_s) should be equal to or greater than the water quality volume (V_w).

For the filtration basin, the storage volume (V_f) should be equal to or greater than 20% of the water quality volume ($0.2V_w$).

Design Methodology for Partial Sedimentation with Filtration

1. Calculate the Basin Surface Areas and Volumes

Filtration basin surface area:

$$A_f = \frac{I_a R}{10} \tag{3.29}$$

Where: A_f = surface area of filtration basin (ac)
I_a = impervious drainage area (ac)
R = runoff depth to be treated (Table 2.2) (ft)

Sedimentation basin surface area:

$$A_s = V_w \left(\frac{1}{D_s} - \frac{1}{10} \right) \tag{3.30}$$

Where: A_s = surface area of sedimentation basin (ft^2)
V_w = water quality volume to be treated (ft^3)
D_s = sedimentation basin depth (ft)

Sedimentation basin and filtration basin volumes:

$$V_w = V_s + V_f \tag{3.31}$$

Where: V_s = sedimentation basin volume (ft^3) (equal to or greater than $0.2V_w$)
V_f = filtration basin volume (ft^3)
V_w = total water quality volume (ft^3)

Specific Design Methodology: Roof Downspout Filtration System

A Roof Downspout Filtration (RDF) system is a trench sand filter system. It is intended only for treating runoff from roofs. Roof gutters must be covered with rigid mesh screens to prevent leaves and other large debris from entering the system. The downspout or the inflow pipe must be connected through a sump catch basin to remove heavy sediment, debris, and floatable material before it discharges into the RDF system.

1. Compute the Area of the Filter Bed (A_f)

Use Figure 3.11 or equation 3.3:

$$A_f = 50 + (I_a - 0.1\,ac) * 167\ ft^2 / ac$$

2. Size the Stone Reservoir

$$V = V_w(1 + n) \tag{3.32}$$

$$A = \frac{V}{d} \tag{3.33}$$

$$V_f = A * (d_f + 0.25) * n \tag{3.34}$$

$$V_{sr} = V - V_f \tag{3.35}$$

$$d_{sr} = \frac{V_{sr}}{A} \tag{3.36}$$

Where:

V	=	total RDF volume (ft^3)
V_w	=	water quality volume (ft^3)
A	=	total RDF surface area (ft^2)
d	=	total depth of system (less than or equal to 5 feet)
V_f	=	volume of sand filter bed (ft^3)
d_f	=	depth of sand filter bed (ft)
0.25	=	depth of pea gravel layer (ft)
n	=	porosity
V_{sr}	=	volume of stone reservoir (ft^3)
d_{sr}	=	depth of stone reservoir (ft)

3. Filter Bed Detail Standards and Specifications Should Be the Same as the Three-chamber Underground Sand Filter

3.1.5 Filtering Landscaping Criteria

A dense and vigorous vegetative cover shall be established over the contributing pervious drainage areas before runoff can be accepted into the facility.

Landscaping is critical to the performance and function of bioretention areas. Therefore, a landscaping plan shall be provided for bioretention areas.

Surface filters (e.g., surface sand and organic) can have a grass cover to aid in the pollutant adsorption. The grass should be capable of withstanding frequent periods of inundation and drought.

Planting recommendations for bioretention facilities are as follows:

- Native plant species should be specified over non-native species.
- Vegetation should be selected based on a specified zone of hydric tolerance.
- A selection of trees with an understory of shrubs and herbaceous materials should be provided.
- Woody vegetation should not be specified at inflow locations.
- Trees should be planted primarily along the perimeter of the facility.

3.1.6 Filtering Maintenance Criteria

Organic filters (F-6) or surface sand filters (F-1) that have a grass cover shall be mowed a minimum of 3 times per growing season to maintain maximum grass heights less than 12 inches.

A stone drop of at least six inches (pea gravel diaphragm) shall be provided at the inlet of bioretention facilities (F-7). Areas devoid of mulch shall be re-mulched on an annual basis. Dead or diseased plant material shall be replaced.

Direct maintenance access shall be provided to the pretreatment area and the filter bed.

The approved erosion and sediment control plans shall include specific measures to provide for the protection of the filter system before the final stabilization of the site.

No runoff shall be allowed to enter the sand filter system prior to completion of all construction activities, including revegetation and final site stabilization. Construction runoff shall be treated in separate sedimentation basins and routed to bypass the filter system. Should construction runoff enter the filter system prior to final site stabilization, all contaminated materials must be removed and replaced with new clean filter materials before a regulatory inspector approves its completion.

Three-Chamber Sand Filter, One-Chamber Sand Filter, Vertical Sand Filter:
The water level in the filter chamber shall be monitored by the owner on a quarterly basis and after every large storm for the first year after completion of construction. A log of the results shall be maintained, indicating the rate of dewatering after each storm and the water depth for each observation. Once the performance of the structure has been demonstrated, the monitoring schedule may be reduced to an annual basis.

The first chamber must be pumped out semi-annually. If the chamber contains an oil skim, it should be removed by a firm specializing in oil recovery and recycling. The remaining material may then be removed by a vacuum pump truck and disposed of in an approved landfill.

After approximately three to five years, the upper layer of the filter can be expected to become clogged with fine silt. When the draw down time for the filter exceeds 72 hours, the upper layer of gravel, geotextile fabric, and sand layer, depending on coloration, must be removed and replaced with new, clean materials conforming to the original specifications.

Perimeter Sand Filter:
During the first year of operation, the cover grates or precast lids on the chambers must be removed quarterly and a joint owner / District of Columbia storm water management inspection made to assure that the system is functioning. Once the District of Columbia inspectors are satisfied that the system is functioning properly, this inspection may be made on a semiannual basis.

When deposition of sediments in the filtration chamber indicates that the filter media is clogging and not performing properly, the top filter fabric and 2"-3" of sand layer must be removed and replaced to refacilitate the filtration process. The coloration of sand should determine how much sands needs to be removed and replaced.

Petroleum hydrocarbon contaminated sand or filter cloth must be disposed of according to District of Columbia solid waste disposal regulations.

Trash collected on the grates protecting the inlets shall be removed at least weekly to ensure the inflow capacity of the BMP is preserved.

Surface Sand Filter:
Major Maintenance Requirements for Sedimentation Basins
- *Removal of silt when accumulation exceeds 6".*
- *Removal of accumulated paper, trash, leaves and debris every 6 months or as required by routing District of Columbia inspector.*
- *Vegetation growing within the basin is not allowed to exceed 18" in height at any time.*
- *Corrective maintenance is required any time the sedimentation basin and sediment trap do not draw down completely after 48 hours (i.e., no standing water is allowed).*

Major Maintenance Requirements For Filtration Basins
- *Removal of silt or sediment when accumulation exceeds 0.5" and paper, trash, tree leaves and debris every 6 months or by order from routing District of Columbia inspector.*
- *Vegetation growing within the filter basin is not allowed to exceed 18" in height.*
- *Corrective measure is required any time drawdown does not occur within 36 hours after the sedimentation basin has emptied.*

Roof Downspout Filtration System:

- *Removal of oil and grease, silt, paper, trash and debris from the pretreatment sump every six months or as necessary.*
- *The system shall be inspected semi-annually by representatives of the owner and the city storm water management inspector to assure continued proper functioning.*
- *When the water will no longer draw down within the required 48 hours period, the subsurface drainage system shall be backwashed with high pressure water to refacilitate the filtration process or total removal and replacement of filter bed and gravel if necessary.*

See Appendix F for additional design and construction specifications for sand filter systems.